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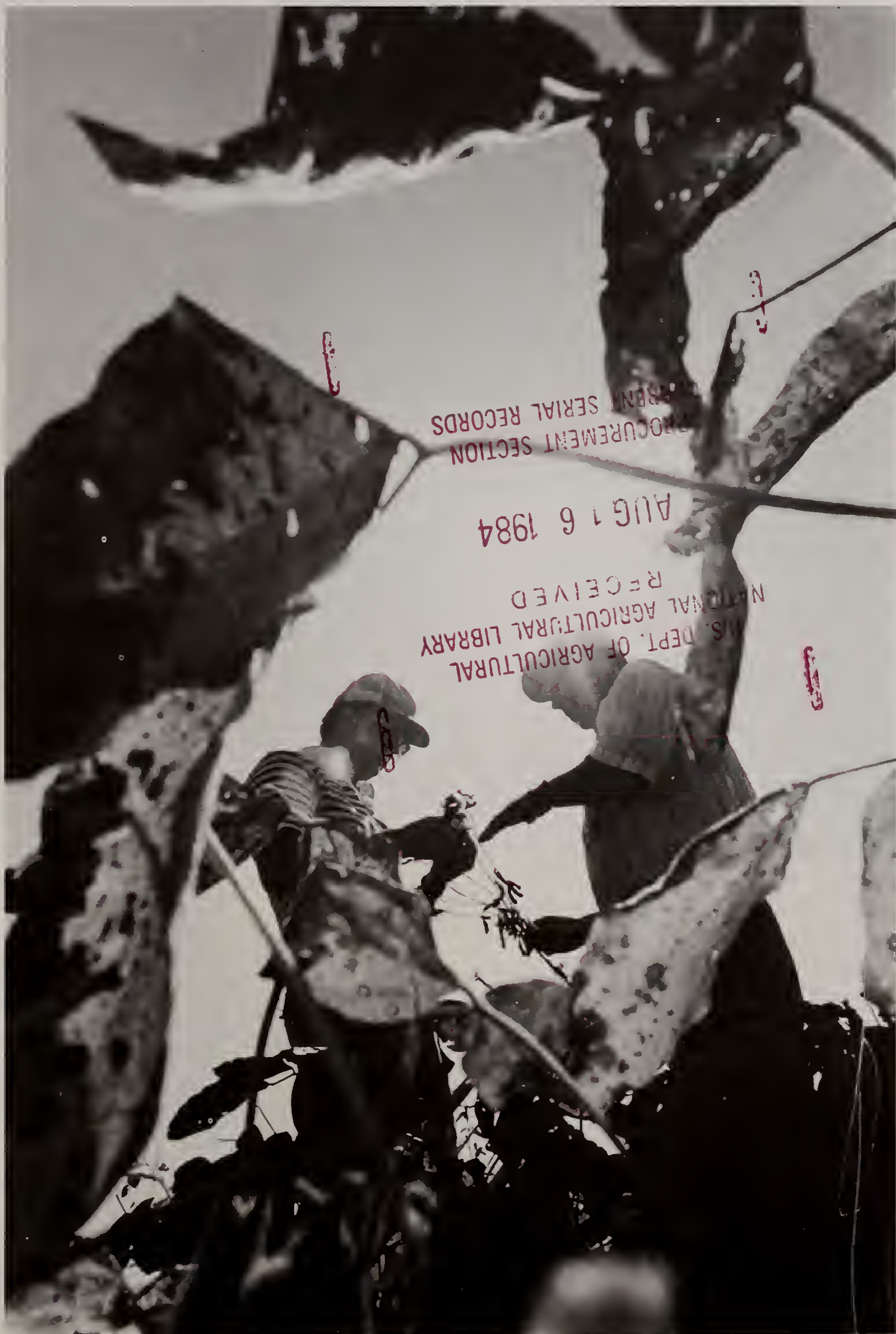

December 1977/Vol. 26, No. 6

Not a Panacea-But a Beginning

For years, we humans have believed that the lifegiving essentials of nature were constant and could always renew themselves. And, if they didn't, well, it was not our problem.

Unfortunately, the time has come for us to accept our responsibilities as guardians of life, as we know it. Agricultural activities produce unwanted sediment, manure, and processing byproducts. Industrial smoke and auto exhaust harm crops and timber.

Chemical and industrial technology have revolutionized agriculture in the past generation. Hundreds of chemicals increase productivity, protect crops, and decrease labor costs and requirements.

In the past, not enough thought has been given to the environmental consequences of our modern technology. But, we are learning, sometimes slowly and painfully, that there are dangers to our Earth. Above all else, our environment—our closed system with limited natural elements—must be protected.

Using unique methods to cope with these environmental problems is not a new challenge to agricultural research. As early as 1888, USDA scientists imported an Australian insect to combat the cottony-cushion scale that was threatening California citrus groves. Breeding of pest-resistant crop varieties began early in this century, and the use of the sterile insect control technique was developed by ARS in the 1950's.

The Pure Food and Drug Act of 1906, which bars contaminants from food, was conceived by Dr. Harvey W. Wiley, then chief chemist of USDA. ARS research on pesticide residues and soil conservation began several decades ago.

ARS scientists will continue to help find answers to many of our ecological problems. Effective, efficient, safe, and enlightened ways of dealing with agricultural wastes are being developed. Alternate ways to control insects through the use of integrated pest management techniques should alleviate many of the concerns over the use of chemical pesticides alone.

We must totally commit ourselves to a new biological ethic to insure the continued success and preservation of our planet. The basic problem, of course, will always remain. How to protect the world's resources, while still harvesting enough to feed the world's population?

Today's research is certainly not a panacea for all of our environmental problems. It is, however, a beginning. For if we neglect the care of our planet today, we will surely pay the price tomorrow.—*M.M.M.*

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COVER: If not carefully applied, herbicides intended for a cotton field might drift into a neighboring crop of soybeans. "Drift damage" to the soybean plants is revealed by brown spots on their leaves, but it could also include arsenic residues detectable only through complex laboratory analyses. For the past 2 years, researchers at the Southern Weed Science Laboratory in Stoneville, Miss., have been studying what can happen if you don't follow the herbicide label. Story begins on page 8 (0977X1198-30).

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Closing of stomata, tiny pore-like openings in the leaves, is the chief way plants control water loss under weather stress. To measure resistance of sorghum to water loss under drought conditions, Dr. Sullivan (left) and graduate student Jerry M. Bennett use a porometer to evaluate stomatal closure. These and other experiments help identify "waterwise" sorghum genotypes to aid plant breeders in developing varieties with even greater dry weather resistance (0877X1150-4).

SELECTIVE BREEDING MAY HOLD THE KEY TO—

Drought Resistance in Sorghum

THE EARLIER the lid is closed, the less water will evaporate from a container on a hot, dry day. But how leaky the container is can be more important than how soon the lid is closed in restricting water loss.

ARS plant physiologist Charles Y. Sullivan (Kiesselbach Crops Laboratory Univ. of Nebraska, Lincoln, NE 68583), works with grain sorghum and corn plants, not containers of water, but similar principles explain some mechanisms of resistance to drought injury in crops. He and associates at the University have identified plant characteristics that may be emphasized in breeding sorghums with greater resistance to hot weather stresses.

Closing of stomata, tiny pore-like openings in the leaves, is the chief way plants control water loss under drought conditions, Dr. Sulivan explains. Closing of stomata is comparable to putting the lid on the container. Corn stomata close somewhat sooner than those of sorghum.

But plants with closed stomata may be somewhat "leaky." Sorghum does a better job than corn in restricting water loss after stomata close. So leaf

Drought resistance in sorghum

Above: Dr. Sullivan and Mr. Bennett gather leaf-disks from sorghum in experiments aimed at determining the plant's ability to tolerate internal stress. In laboratory tests, the leaf-disk samples are subjected to heat and drought. The resulting injury is analyzed by measuring electrical conductivity of electrolytes leaking from damaged cell membranes (0877X1149–31).

Right: *In related research, Dr. Sullivan (left) and Mr. Bennett compare root growth of various sorghum genotypes. These roots are grown in a liquid nutrient solution so that root systems can be readily observed and measured for such quality factors as size, number of main roots, root branching, dry weight (after cutting and drying), and shoot-to-root ratio (0877X1151–36A).*

drying continues in corn, and damage and death of cells—firing—occurs sooner than in sorghum.

Dr. Sullivan and Jerry D. Eastin, Nebraska plant physiologist, also found that sorghums differ significantly in drought resistance, which includes mechanisms for avoiding or tolerating both water and heat stresses. Desiccation tolerance describes the water loss a plant can withstand before half of the leaf cells die. Heat tolerance is the plant's ability to live and function when tissue temperatures are high. Tolerance to the two stresses may or may not be correlated.

A combination of plant characteristics contributes to tolerance of these stresses, says Dr. Sullivan.

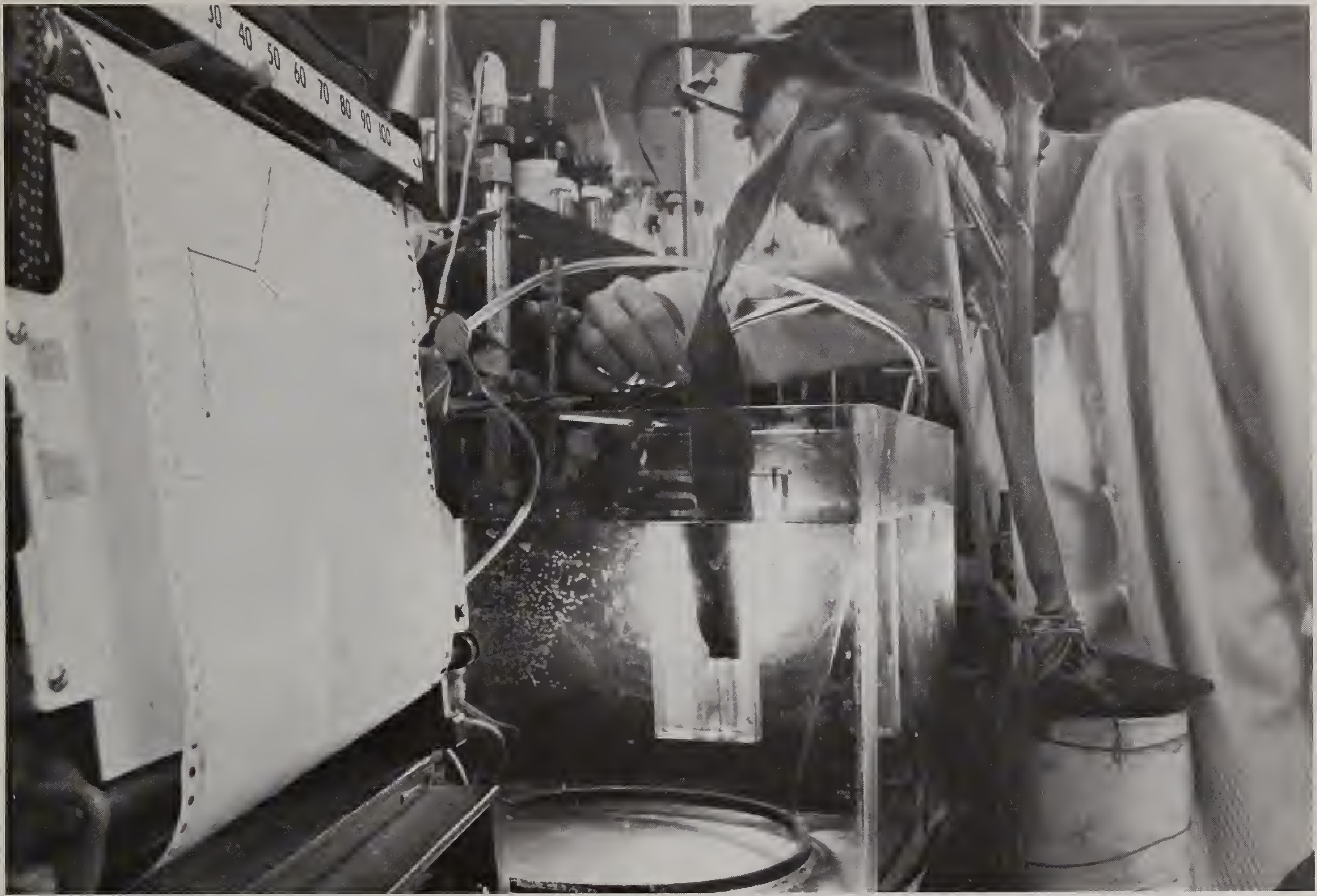
Sorghum leaves, for example, have a significantly heavier covering of cuticular substances, primarily waxes, than corn leaves. Sorghum hybrids vary in the amount of waxy covering. And Dr. Sullivan found that the hybrid with the heaviest protective covering was also the most drought resistant of several similiar hybrids.

The greater drought resistance of sorghum is not necessarily due to leaf cells tolerating greater internal stress, Dr. Sullivan found. Heat injury to cells of two sorghum hybrids was two and three times that of corn cells, and desiccation injury to cells was significantly higher in one sorghum hybrid. Selective or adaptive mechanisms apparently have developed in corn, he says, because its cells are exposed to greater internal stress. Earlier closure of corn stomata decreases exaporative cooling, and less effective restriction of water loss after stomata close promotes desiccation.

One of the pluses for sorghum is its ability to extract more of the water from shallow depths in the soil. After 36 days of drought stress, sorghum had removed more water from a 6-inch depth than corn, although corn had done a better job of pulling water from an 18-inch depth.

Another study indicated that distribution of sorghum roots in the soil may influence desiccation and heat tolerance. The more tolerant of two sorghums had a higher proportion of total root weight in the top 60 centimeters of soil—about 3 percent more in the top 30 centimeters and about 5 percent more between 30 and 60 centimeters. The less tolerant sorghum had nearly twice the percentage of its roots at a depth of 90 to 120 centimeters, indicating greater avoidance than tolerance of drought.

Dramatic differences in rate of photosynthesis in sorghums were also demonstrated by graduate student Norma V. Norcio and Dr. Sullivan. The sorghum



Student research assistant Cynthia A. Ellis measures the effect of high temperature on oxygen exchange—one of the processes of photosynthesis. Researchers found dramatic differences in the rate of photosynthesis in selected sorghum genotypes under specific high temperatures (0877X1154–13).

with the highest photosynthesis rate at 102° F. outperformed the lowest one by 50 percent. At 105°, three of seven sorghums either maintained or increased photosynthesis rate, while the rate decreased or photosynthesis ceased in the others. Leaf disks taken from the three sorghums showed the least injury when exposed to 120° temperature for 15 minutes.

These tests indicated variation in heat and desiccation tolerance that might be exploited by sorghum breeders—if tolerance is inherited.

Another series of experiments demonstrated the inheritance of tolerance. On the basis of heat and desiccation tolerance tests the researchers, cooperating with ARS sorghum geneticist W. M. Ross, selected 21 closely related lines as high, medium, and low in drought resistance. The lines showed 37 to 60 percent heat injury and 62 to 72 percent desiccation injury when tested under stress. After growing the lines two seasons in the field, the scientists grew three of them in a controlled greenhouse environment. When stressed, the two lines previously selected for high heat and desiccation tolerance showed much less injury than the line selected for low tolerance.

In the field, sorghums selected for high heat tolerance generally did not produce the highest yields in a season when there was little drought stress. Under high temperatures and drought conditions the next year, the heat-tolerant lines produced the best yields.—*W.W.M.*

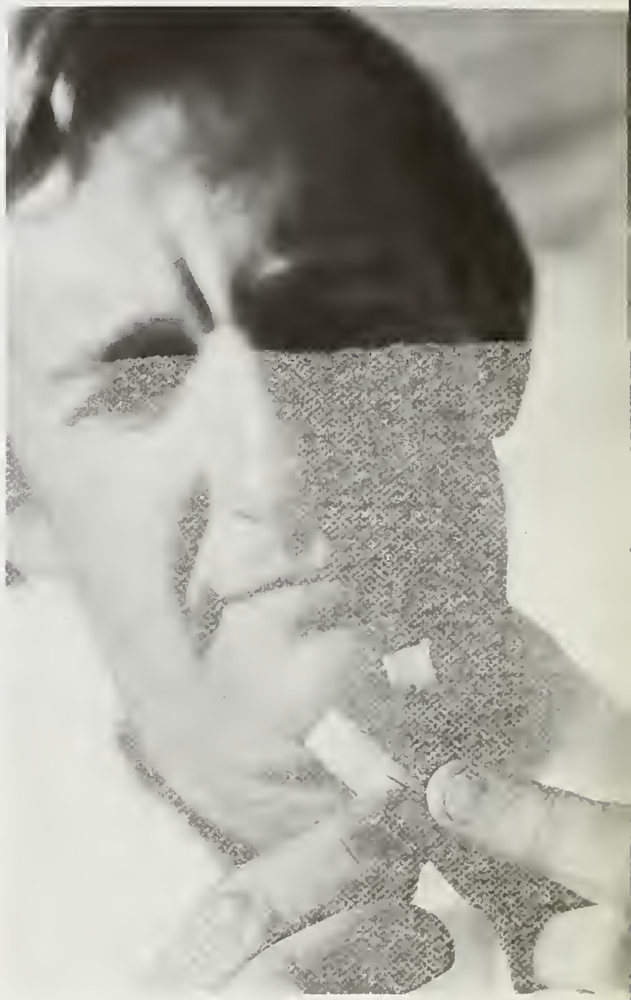
Some sorghum plants "remember" drought stress, and their stomata do not open as widely when rewatered as they were before drought.

Ms. Norcio and Dr. Sullivan found that a water conservation mechanism seems to develop in some drought-stressed plants. They can be differentiated from plants lacking this mechanism by a higher level of the biochemical abscisic acid.

Abscisic acid levels generally increase when plants are exposed to drought conditions that trigger closure of stomata, they found. Levels of free abscisic acid remain higher in sorghum plants with stomata partially closed after rewatering than in those plants whose stomata again open fully.

Left: Core samples are removed from sugar beet roots by biological laboratory technician Gary Nielsen (foreground) and placed in a culture box by Dr. Bugbee. After being filled with several hundred cores, the culture box is kept in an incubator for 2 weeks at 20–22° C. (0677B820–31).

Below: Dr. Bugbee compares cores from rot-resistant and rot-susceptible roots 2 weeks after both varieties were exposed to storage-rot pathogens (0677B 821–2A).



Genetic Resistance. . .

POSSIBLE ANSWER TO SUGAR BEET PATHOGENS

SEVERAL MILLION POUNDS of sucrose annually leave sugar beet growers' farms but never enter a sugar factory. This sucrose is lost to storage rots while the beets are piled awaiting processing.

Extension of genetic resistance to include principal storage rot pathogens now promises to restrict these losses, says ARS plant pathologist William M. Bugbee, Sugarbeet Disease Research Laboratory (210 Waldron Hall, North Dakota State University, Fargo, ND 58102). Two breeding lines carrying resistance to these pathogens are now available to breeders of sugar beet hybrids.

Dr. Bugbee estimates that 5.7 million pounds of sucrose were lost to storage rots in the Red River Valley of North Dakota and Minnesota in the 1974–75 processing season. His estimate is based on data obtained by sampling beets as they entered a factory. He says the total loss on a national basis may be five times that in the Red River Valley.

Sources of resistance to storage rot pathogens are rare, Dr. Bugbee says. A survey in 1973 indicated no varieties grown or being introduced in the Red River Valley were resistant to the fungus *Phoma betae*, and only 8 of 3,700 roots were promising in an early screening for resistance.

Breeding lines introduced from the U.S.S.R. and considered resistant there

performed poorly when exposed to U.S. isolates of rot pathogens. These lines proved to be excellent sources of individual roots with desirable levels of resistance.

The pathologist developed the multigerm pollinator lines, jointly released by ARS and North Dakota State University, from two sources—the Russian introductions and a line originally selected by ARS for resistance to rhizoctonia crown rot.

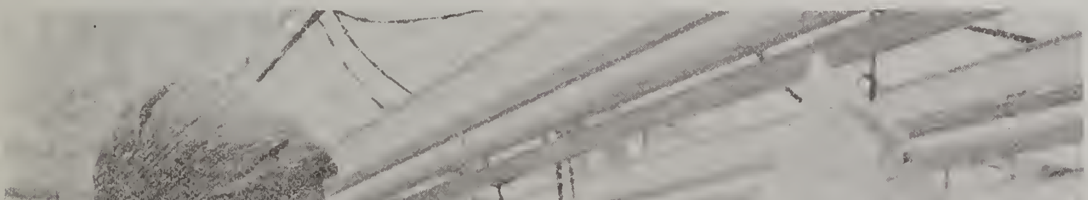
The resistance source designated F1001 has a high level of resistance to *P. betae* as well as moderate resistance to *Penicillium claviforme*. This line is the result of two generations of selection from two roots introduced from Russia. The line F1002, carrying a high level of resistance to *P. betae* and moderate resistance to *Botrytis cinerea* and *P. claviforme*, was developed in three generations of selection from one root of the rhizoctonia-resistant line.

P. betae is the principal cause of storage rot in the Red River Valley, Dr. Bugbee says, while both *P. betae* and *B. cinerea* are important in Western States. Rarity of botrytis rot in some production areas perhaps may be explained by his finding that an isolate of *B. cinerea* was completely inhibited in sugar beet tissue by an isolate of *P. claviforme*, while an isolate of *P. betae* was not.

The scientist says *P. claviforme* is less pathogenic than the other two fungi but still could cause serious storage losses if extensively disseminated in a storage pile.

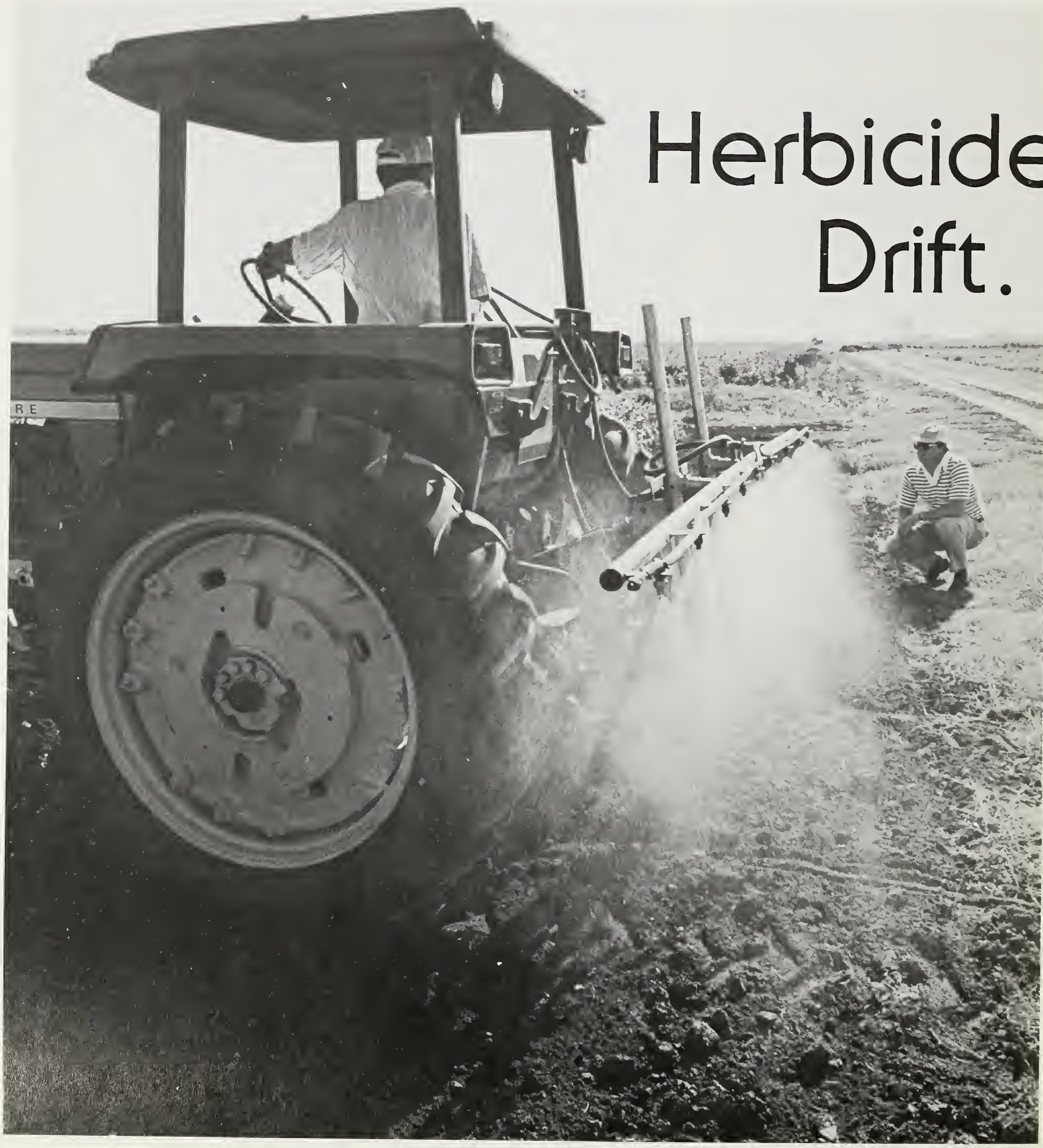
Dr. Bugbee says *P. betae* is a seedborne fungus that often causes seedling disease if seed is produced in a humid environment. Many plants infected as seedlings go on to produce normal, healthy looking roots. The fungus is still active and causes decay after roots are harvested and stored.

Prevalence of *Phoma* in seed stocks ranged from 0 to 24 percent in one study. Dr. Bugbee identified the fungus in 51 percent of beets randomly selected from storage sites and found that it survives in soil at least 26 months after beets are planted.—*W.W.M.*



Above: Dr. Bugbee checks spacing between soybean plants whose roots have been selected for resistance to storage rot pathogens. The plants will be harvested and their roots again evaluated for resistance to storage rot in winter (0677B821-32A).

Left: Dr. Bugbee examines a resistant strain of seed plants to see if they are ready for field planting. Plant flowers are covered by cloth bags to prevent the movement of pollen (0677B821-8A).



Herbicide Drift. . .

Right: Dr. Wauchope notes peaks (indicating arsenic) in graphic readout of gas content inside atomic absorption spectrophotometer. Until about 5 years ago, chemical analyses of environmental samples for arsenic were difficult and time consuming—and therefore rarely done. Flameless atomic absorption spectrophotometry has made arsenic detection comparatively easy and an almost routine laboratory procedure (0977X 1196–28).

Far right: Searching for arsenic residue: biological laboratory technician W. L. Simms injects one ml. of acid-digested soybean meal into a solution of sodium borohydride that will convert any arsenic present into arsine gas for analysis through flameless atomic absorption spectrophotometry (0977X 1197–18).

...Avoiding the Damage

Increasing the size of herbicide spray droplets can considerably reduce the likelihood of their being caught by a breeze. A small amount of "drift control agent," when added to the spray tank, prevents formation of "mist" (left, 0977X1198–22) and produces a spray with heavier droplets (right, 0977X1198–11).

SOYBEANS AND COTTON do not always make good neighbors. Often grown in adjacent fields in the Southeast, their proximity may subject the soybeans to spray drift from application of the widely used cotton herbicide MSMA—monosodium methanearsonate.

MSMA is applied either over-the-top to cotton and weeds or as a directed spray to the foliage of the weeds. After cotton begins to produce flowers, applications may result in arsenic residues in the harvested cottonseed, so there are label restrictions against using MSMA after the cotton begins to bloom.

To see if arsenic that drifted on neighboring soybeans might result in residue in the beans, MSMA was applied over-the-top in Stoneville, Miss., to soybeans at different stages of growth, using 1/20 to 1/5 the normal application rate to assess damage under simulated drift conditions. Soybeans were sprayed at four stages of growth, at intervals from the 2nd to the 11th trifoliolate leaves (a trifoliolate leaf has three leaflets) and at midbloom. The herbicide was applied at the rate of 0.11, 0.22, and 0.44 kilogram per hectare.

These treatments were replicated three times in each of 2 years. At maturity, the soybeans were harvested from each treatment plot and from unsprayed control plots and stored in a freezer until analysis.

The soybeans were then ovendried and ground in a mill; 4-gram subsamples were digested with a condensor system and perchloricnitric acid. The arsenic content was analyzed using methods developed at Stoneville.

Soybeans were also washed thoroughly with water, which was then analyzed; no residues were found in the washings, indicating that any arsenic found by digestion was not due to surface contamination.

Chemist R. Don Wauchope and plant physiologist Chester G. McWhorter at the Southern Weed Science Laboratory (P.O. Box 225, Stoneville, MS 38776), found residues in the mature soybean seed when the plants were exposed to MSMA late in the season.

Conversely, treatments applied at the early growth stages did not result in residues, even though soybean injury and some yield reductions occurred.

The scientists concluded that the absence of residues from early-season application of MSMA indicates that there is little danger of MSMA drift leading to arsenic residues in neighboring soybean crops when the herbicide is applied early in the season.—*P.L.G.*

Selectively Bred Swine

TYPICAL COMMERCIAL HOGS today produce a fourth more lean pork per pound of feed than those raised in the 1950's, and hogs selected solely for low backfat for more than 20 years improved conversion of feed to lean gain nearly as much.

Today's sows tend to grow more rapidly, reach heavier weights, carry less fat, mature later, and produce heavier pigs at birth but not larger litters than those of two decades ago, an ARS study shows.

The comparison of contemporary hogs, those of the 1950's, and experimentally selected breeding lines suggests the direction of selection emphasis for further breed improvement, says ARS geneticist Gordon E. Dickerson. (U.S. Meat Animal Research Center, University of Nebraska, Room 225, Marvel Baker Hall, Lincoln, NE 68583).

For general-purpose breeds intended for rotation crossing, he says, selection for increased litter size and against backfat measured by probe should receive about three times the emphasis of selection for average daily gain. In breeds intended mainly for producing crossbred gilts, however, Dr. Dickerson suggests reducing emphasis on average daily gain and backfat about half from this ratio. Litter size should receive sharply reduced emphasis in relation to gain and backfat in lines intended for producing sires of market pigs.

A selective breeding project initiated in 1954 by ARS geneticist Herbert O. Hetzer at Beltsville, Md., offered a unique opportunity for measuring industry progress and potential for genetic improvement by selective breeding (AGR. RES., Sept. 1958, p. 3).

Three pairs of breeding lines were maintained—Durocs and Yorkshires selected for low backfat, lines selected for high backfat, and unselected lines typical of the breeds in the 1950's. Contemporary Durocs and Yorkshires were added when the project was transferred to Nebraska, where four crosses of similarly selected Durocs and Yorkshires were compared.

Selection for low backfat alone by breeders and by researchers each improved feed conversion to lean meat but by different routes, Dr. Dickerson points out. Industry selection gave faster lean gains; low backfat selection reduced fat deposition and feed consumption.

Contemporary crossbred pigs reached 220-pound weight 30 days sooner than the low-backfat crosses, at a 17 percent savings in nonfeed costs. The contemporary pigs gained 27 percent more lean per day than the crosses representing 1950's breeding, he says, while rate of lean gain was up only 6 percent in the low-backfat line. Live weight daily gain was 9 percent more in contemporary pigs than in controls and 10 percent less in low-backfat pigs.

The more rapid progress toward leaner carcasses from selection for low backfat is reflected in the lower daily feed consumption, Dr. Dickerson found. Contemporary pigs ate 3 percent more feed daily than those of 1950's breeding, while the low-backfat crosses ate 14 percent less. Producing a gram of lean tissue requires approximately half as much dietary energy as producing a gram of fat, the scientist points out.

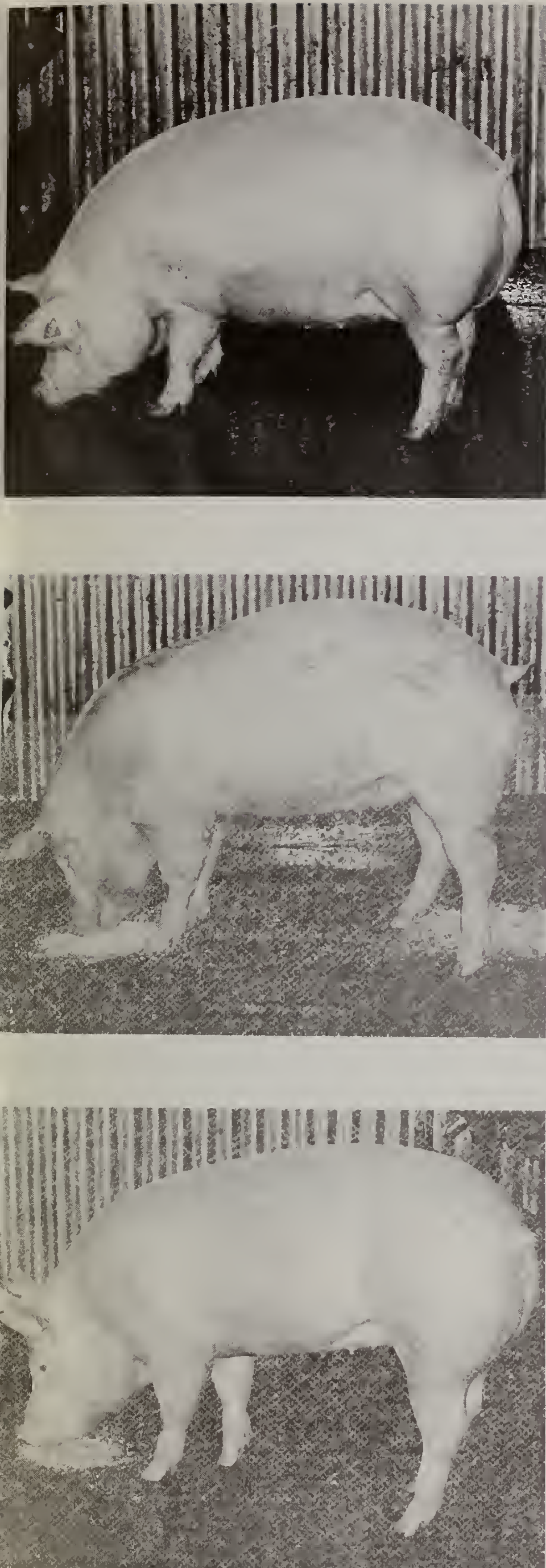
Selection for high backfat over 20 years, as expected, produced extremely fat pigs. This cross gained 19 percent less lean per day than controls and was 20 percent less efficient in feed utilization for lean growth.

Dr. Dickerson says contemporary crossbred sows made 9 percent faster total gains, and 27 percent faster lean gains, to 220-pound weight than those from unselected lines representing 1950's breeding. About 15 percent larger sow weight was associated with the more rapid gain of contemporary crosses. Similarly, the 21 percent smaller sow size of high-fat crosses was associated with 19 percent slower lean growth.

Heavier mature weights for sows result from industry efforts to produce more rapid lean gains in market pigs, the scientist says. An offsetting effect is additional cost to maintain the larger sows. The increased cost of sow maintenance should not greatly affect net production expenses per pound of pork produced, Dr. Dickerson says, because the reproduction rate is high in pigs.

Dr. Dickerson and geneticists Howard S. Teague and Lawrence D. Young found that contemporary and high-backfat sows reached puberty about 3 weeks later than low-backfat and 1950's sows. Contemporary and low-backfat sows were ready for rebreeding after the first litter later than the high fat and control groups. These sows were a week older at farrowing than the controls, and gestation was about 1 day longer.

The study, in cooperation with the University of Nebraska, Lincoln, showed that contemporary and low-backfat sows produced pigs averaging 3 pounds or more at birth, a quarter-pound to a half-pound heavier than those of the unselected 1950's sows. Pigs from high-backfat sows were a third-pound smaller than controls. The 96 percent survival of pigs from the smaller high-backfat sows contrasted with 79 to 83 percent survival for the other three groups of pigs.—*W.W.M.*



Results of different breeding programs can be seen in this comparison of sows bred for high backfat (top, PN–4151), low backfat (middle, PN–4152), and a gilt typical of the current purebred cross (bottom, PN–4153).

P.L.480 Project . . .

Rhizobia Potential

HIGH ENERGY requirements for fixing nitrogen (N) from the atmosphere are making N-carrying fertilizers increasingly costly. To relieve some of the heavy dependence on chemically synthesized nitrogen compounds, ARS scientists are working to improve the N-fixing efficiency of *Rhizobia* associated with legume root nodules. They are also working to select microorganisms that can fix N when growing with roots of such important non-legume crops as corn and other cereal grains. The world's legumes, which include beans and peas, are estimated to fix 35 million metric tons of atmospheric N annually—at present prices, a value of $8.4 billion.

A Public Law 480 project in Poland is complementing the ARS research by concentrating on *Rhizobium meliloti*, the microorganism which can fix N in root nodules of alfalfa, medic, bur clover, and sweet clover.

The Polish scientists are studying the biochemistry of *Rhizobium* effectiveness in infecting its hosts and are genetically mapping the traits involved in this process. They found that the effectiveness of the microorganism is correlated with its capacity to synthesize the amino acid leucine.

The Poles are also investigating the possibility that the nitrogen fixation (nif) genes could be located on DNA structures which can reproduce autonomously and are independent of *Rhizobium* chromosomes. Potential results of this investigation are the possibility of increasing the quantity of nif genes and thereby increasing N fixation efficiency.

Plant physiologist and ARS-cooperating scientist Charles Sloger, Cell Culture and Nitrogen Fixation Laboratory (Beltsville Agricultural Research Center, Beltsville, MD 20705), says expanded basic genetic research on biological nitrogen fixation in *Rhizobium* is needed.

Dr. Sloger says, "We need to identify and map the genes in *Rhizobium* that are directly and indirectly involved in the nitrogen fixation process and to develop methods for the transfer of nif genes between *Rhizobium* strains."

The Polish work is being conducted under the direction of Dr. Zbigniew Lorkiewicz at the M. Curie-Sklodowska University, Lublin.—*M.C.G.*

Left: Blueberries in this graduated cylinder are about to be penetrated by a cherry-pitting probe connected to highly sensitive electronic recording equipment. A "puncture force curve" generated by the probe as it pushes through the berries will reflect both the toughness of their skin and the firmness of their flesh. The blueberry at the bottom is sitting on a pillar of wax—a unique improvisation for this kind of test which enables the probe to go further for a more complete (and thereby more accurate) reading (0677B815-10A).

True Blue Blueberries

While color, firmness, and texture might be proof enough at the grocery store, scientifically verifying the benefits of spraying blueberries with SADH-ethephon requires more objective criteria. Here, stained cross sections of tissue from treated and untreated blueberries are examined by Dr. Dekazos for cell size and cell wall thickness (0677B814-12).

FATS DOMINO found his musical "thrill on Blueberry Hill" back in the '50's; today consumers can find their thrill in tasting blueberries that are bluer, ripen faster, and store longer. Two growth regulators applied as preharvest fruit sprays make the difference.

They are SADH, (succinic acid-2,2-dimethylhydrazide), and ethephon, (2-chloroethyl) phosphonic acid, used singly and in combination on rabbiteye blueberry plants grown commercially in Alma, Ga.

Blueberry may be just another flavor of breakfast jam to the urbanite, but in developing rural areas of the South this fruit represents a cash income. The fact that it matures at various times—over a range of 3 to 5 weeks—presents a severe mechanical harvesting problem. But the enhanced color brought about by ethephon or SADH-ethephon advances and concentrates fruit ripening, a distinct advantage for mechanical harvesting.

Plant physiologist Elias D. Dekazos at Russell Research Center (P.O. Box 5677, Athens, GA 30604), reports that in 5 treatments on rabbiteye blueberries (cultivar 'T-19') all fruit receiving ethephon treatments ripened significantly earlier.

Applications of ethephon and of SADH-ethephon brought 95 percent of the berries to full ripeness by the date of harvest while control bushes yielded

only 36 percent. The treatments not only advanced maturity, but also reduced the length of the harvest period by 1 week.

The ethephon spray also accelerated fruit abscission, the point where fruit loosens and falls from the bush. Multiple applications of ethephon and SADH-ethephon had no significant effect on berry size but improved quality of the fruit.

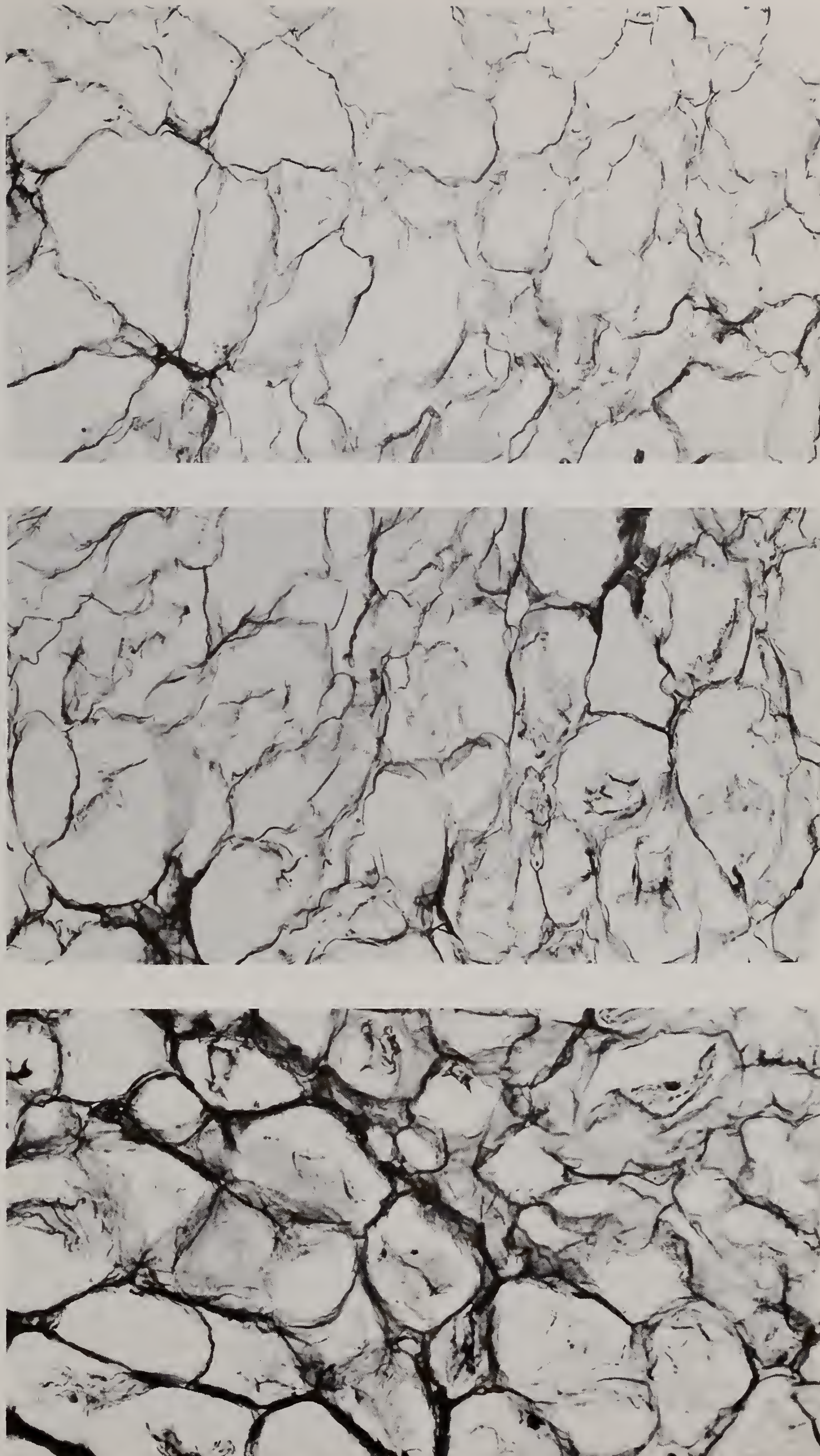
Application of SADH alone increased blue color by 7.4 percent, ethephon alone increased the color by 15 percent, and SADH-ethephon by 22.1 percent compared to unsprayed plants. The effect of SADH and ethephon on fruit coloring seems to be additive. The application of SADH-ethephon affected the cell wall thickness and texture of sprayed berries, yielding fruit with the best firmness.

Importantly, the SADH-ethephon treatment drastically suppressed the rate of softening of stored berries. Dr. Dekazos also observed that ethephon-treated berries had less mold; the effect was to extend storage life.

Another important quality characteristic—the natural waxy bloom which gives the appearance of freshly harvested blueberries—was retained after 40 days storage by the fruit sprayed with SADH and/or ethephon. That natural waxy bloom which makes them desirable to the consumer was not found in the control berries, which were judged by an informal taste panel to have an off-flavor, a darker appearance, and a mealy texture.

"The advanced and concentrated ripening of 'T–19' blueberries will not only be an advantage for mechanical harvesting, but the improved fruit texture from SADH-ethephon will be an asset to immediate fresh market acceptability," says Dr. Dekazos.

Registration by the Environmental Protection Agency for both growth regulators has been approved for apples and cherries as well as for blueberries—*P.L.G.*



Microphotographs show how blueberries treated with SADH-ethephon have thicker cell walls (bottom, PN–4149) than either untreated blueberries (top, PN–4147) or those treated with ethephon only (middle, PN–4148). For both the consumer and producer, thicker cell walls translate into enhanced color, increased firmness, accelerated ripening, better harvesting, and longer storage life.

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